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A GUEST LECTURE ON
"POWER ELECTRONICS IN SMART GRID"

Date: 14-08-2018

REPORT

The Electrical and Electronics Engineering department has organized a **Guest Lecture** on **"Power Electronics In Smart Grid"** on **11th August 2018**. The resource person was **Dr. V. Naga Bhaskar Reddy**, Professor & HOD, Rajeev Gandhi Memorial College Of Engineering & Technology, Nandyal. The III & IV year students of EEE department have attended this guest lecture.

Resource Person Profile:

Dr. V. Naga Bhaskar Reddy working as Professor & HOD, Rajeev Gandhi Memorial College of Engineering & Technology, Nandyal from November 2004. He has 17 years of academic experience. He completed his Doctor of Philosophy (Ph.D) in Power Electronic Converters & Electric Vehicles. He published total 25 research papers in international reputed publications in the areas of power electronics, renewable energy technologies, power quality and more.

About Power Electronics In Smart Grid

The biggest technological revolution in the last decade is "Smart Grid". As compared to the conventional grid, smart grid is automated, highly integrated, technology driven and modernised grid. In coming years smart grid will have a key role in transforming the electrical networks, its topology and power system operation. Energy efficiency, electricity supply and sustainability are the foundation pillars of smart grid technology.

The reliability of electric supply has become the utmost priority of consumers in developed as well as developing countries throughout the world. Through smart grid implementation, monitoring, control and real time measurement of generation, transmission and distribution of electrical energy has become possible and hence reliability of electric supply is improved. Smart grid has the potential to reduce the carbon footprints by integration of renewable energy sources, energy storage and plug-in hybrid electric vehicles with the main grid.

Power electronic devices such as Metal Oxide Silicon Field Effect Transistor (MOSFET), Insulated Gate bipolar Junction Transistor (IGBT), Integrated Gate Commutated Thyristors (IGCT), Gate turn off Thyristor (GTO), Triode as an AC Switch (TRIAC) etc. has high current carrying capacity and high voltage handling capacity also. They have higher switching frequencies which is useful characteristics for voltage magnitude conversion and frequency control. These devices are used in converters. Depending upon the converter topology these converters are able to control the power flow also. Power electronics therefore plays a vital role in smart grid implementation and its development.

The forenoon session started with keynote lecture on Smart Grid which is the interconnection of generating stations and load centre and its importance in electrical power systems. It also provided the insights of power grid which includes Need of power grid, Site selection for power grid, Layout design, Bus bar schemes and Drawing of electrical layout. The resource person also explained the functioning of each block in the layout of the smart grid.

The afternoon session continued with the **Applications of power electronic devices in Smart Grid**

Volt-Var Optimisation

Power electronic voltage regulators using TRIAC are used to regulate the voltage on the distribution feeders. The capacitor banks are used to boost the voltage of the line by generating Vars.

For integration of renewable energy sources

Exponential growth of renewable energy has been enabled in recent years, this is only because of technological advances in ‘Power Electronics’ devices and their ability to control power flow. Power electronics based Flexible AC Transmission (FACTS) technologies and automation technologies are necessary for smooth integration of renewable energy sources with the main grid.

Different energy sources are integrated with power electronic interfacing technologies as follows:

Large wind farms have been connected increasingly with the grid using technologies such as Power Electronic Voltage Source Converters (VSC), HVDC systems consisting of Dual Converters, FACTS and Static VAR compensators (SVC) with energy storage system. Now a days, Full scale converters are used as power electronic interface which is placed between the wind turbine generator and the main power Grid. This interface satisfies the generator and grid side requirements. These converters always ensure that the turbine speed is adjusted so that maximum power can be generated. Also, on the grid side, regardless of the speed of wind, this power electronic interface, controls frequency, active, reactive power as well as voltage. The wind turbine generators, whether it is Double-Fed Induction Generator (DFIG) or variable speed Permanent Magnet Synchronous Machine (PMSM) rotate at asynchronous speed with respect to the frequency of the grid. DFIG uses Partial scale converters which are two-level Pulse width modulation Voltage source converters (VSC) and which have 30 per cent capacity of the wind turbine. These converters work at optimum operating points of the machine to produce electrical energy at 50/60Hz.Technically it shows full power controllability with a simple structure which is reliable and cost effective. For off-shore applications,

Wind turbines with Permanent Magnet machines always require full scale converters. These converters are mostly three-level Neutral point diode clamped back-to-back converters. These converters respond to frequency changes on both sides of DC link. The output power of the converters can be adjusted to maintain the system frequency. These types of converters give one more output voltage level and less dV/dt stress as compared to two-level converters. Therefore, it is possible to convert power at medium voltage level and lower current and use smaller filter size. These power electronic converters are simple modular structures with compact designs based on high power semiconductors, Integrated Gate Commutated Thyristors (IGCT) or Insulated Gate Bipolar Junction Thyristors (IGBT). Due to their compact design, these converters can fit inside the turbine tower along with the grid harmonic filters and generator harmonic filters.

For Electric Mobility in Smart Grid Environment

The main Purpose of Electric Vehicles is to fulfil all mobility needs at the costs equivalent to those of the conventional vehicles taking into consideration green-house gas emission reduction. The power train system of Electric vehicle consists of power electronic building blocks. such as voltage regulators, Choppers (DC-DC converters), Traction Inverters

(DC-AC converters), on- board charger etc. Alternators require Voltage regulators are required to produce constant voltage at the battery terminals by modulation of field current. Choppers (DC-DC Converters) are used for soft-switching where the switches are subjected to low stress and therefore give longer -life. These covert 400 V to 12V in electric vehicle. As AC motors have high efficiency instead of DC motors, AC motors are used in Electric vehicles. Traction Inverters (DC-AC inverters) are used for to supply power, to AC motors which is stored in batteries of the Electric vehicle. On -board chargers are power electronic converters in rectification mode used to convert AC to DC in order to charge the batteries in the electric vehicle. All other components also like ignition switch, control module, vehicle speed sensor, steering sensor etc are power electronics devices.

CONVENOR **HOD**